some religious conception, we might feel inclined to trace the origin of American cup-cutting to Asia. But if, on the other hand, the cups were designed for a practical purpose, the custom of excavating them may have sprung up in America, as well as elsewhere.

## THE ECLIPSE EXPEDITION

THE following letter from its Special Correspondent with the English Eclipse Expedition, appeared in the *Daily News* of Tuesday :—

*Sohag, May* 19

Still at Sohag! but how different is the place now from what it was when I first sighted it—as it seems, years ago. Then the solitary steamer and the tents of the French party were hardly sufficient to break the shore line as we looked at it, alas for too long a time, from the place of our last *ensablement*. But now the steamer is lost in a fleet of dahabeeahs, and the line of tents and shelters has been extended for some distance towards the town; but tents are coming down, the hot sand is being strewed with boxes, and in 24 hours nothing will be left but some brick piers, which the next high tide will make short work with. Yes, something will be left. Sohag will have taken its place in scientific history by the side of many other out-of-the-world places, which seem to be chiefly affected by eclipses, and its memory may still puzzle the dryasdusts of the future.

As the 17th approached the excitement of almost everybody visibly increased, and as the energy waned the tension waxed. A little wind eddy of fearful violence, which produced a small sand-storm on the land, and almost a waterspout as it tore its way out of sight across the Nile, after hurling down one of the French tents and driving the dahabeeah occupied by the English party from its moorings, was almost a relief; and a further variety was introduced into the monotony of heat and work by the arrival of the dahabeeahs and the final visit of the Governor-General to the astronomers and his new visitors, Aly Pacha Cherif (son of Cherif Pacha, Minister of Mohamet Aly); Osman Pacha Galeb, Governor-General of Assiout; Mahmoud Pacha, director of the Cairo Observatory; Mohamed Bey-el-Kakim, and others being among them. On this occasion the Governor-General Aly Pacha Riza was accompanied by Teidrous Effendi, chief judge, and Mohamet Effendi Kamil, one of the judges of his province, and his aide-de-camp Moustafa Effendi Sirry. The commandant of the garrison of Sohag was also in attendance. Moktah Bey, as usual, acted as interpreter, and the final arrangements for the eventful day were made. First among these the military guard had to be largely strengthened, for not only is a very pardonable curiosity a thing to be utterly suppressed during eclipses, but a whisper had gone abroad that the False Prophet of the Soudan had included the eclipsers in his anathemas, and even one fanatic in the camp at Sohag might give a deal of trouble. And at last the 17th came, ushered in by the finest morning we had had—(clouds had been terribly persistent for several previous days at the time the eclipse was to happen)—and when the observers turned out at dawn to put the final touches to their preparations the local excitement had begun to show itself. On the hill, under palm trees, between us and Sohag there was already a great crowd, which rapidly increased; but a cordon of sentries round the camp kept everything quiet within.

And now for the actual work. In an eclipse there are four critical points: the first, second, third, and fourth contacts, so called—the first when the moon makes its appearance on the sun, the second when its first totality obscures it, the third when the sun again reappears, and the fourth when the sun is quite clear of the moon again. It is of course with the totality—that is, the time that the sun as we know it is invisible between the second and third contacts—that the physical astronomer has almost exclusively to do, but as some of the phenomena are visible slightly before totality the time has to be carefully watched. During totality this has to be done in the most steady manner, and the observer upon whom this duty falls has a most responsible task. In the English Observatory, to which I shall now confine myself, this fell upon Mr. Buchanan; and as the arrangement adopted this time was new, I will describe it. It was devised by Mr. Lockyer as the result of his Indian experience, when the timekeeper found it so difficult to keep the time and to observe the eclipse, which he had come 600 miles to see, that he resolutely turned his back upon the sun lest he should fail in his self-imposed task and so disturb the work of others. What one wants to know at any moment during an eclipse is for how many seconds the phenomenon is yet to be visible and when each ten seconds of the totality have flown away, as each observer has generally more than one thing to do, and the announcement of the timekeeper is the signal for changing his instrument. On this occasion a clock used for testing gas meters was employed, with a seconds pendulum set going at the moment of totality, and with a large dial marked 65, 60, 50, 40, and so on to 0; 65 being the number of seconds which it was thought would leave a safe interval for covering the lenses of all the cameras before the actual termination of the eclipse. The plan answered admirably. Mr. Buchanan sang out the times shown on the dial, and sketched the eclipse with perfect ease.

While the land was darkening and the sky and the Nile were beginning to put on those indescribable hues round which so much of the terror of eclipses is centred, and while the whispers on the hill at Sohag were beginning to surge into a sound—half roar, half moan—some eight minutes before totality, Mr. Lockyer announced the appearance of bright lines, indicating that our atmosphere was already dimly illuminated enough to permit of the atmosphere of the sun being seen through it, and it was easy to see by the rapid pencilling on a copy of Angström's map, which was arranged on a stand under the eye-piece of his spectroscope that observations in earnest had commenced. This went on, the image of the retreating cusp of the sun being carefully kept on the slit of the spectroscope, by Mr. Lawrence until Dr. Schuster, as had been arranged, announced the instant of totality. At this signal Mr. Buchanan said, "65 seconds," Mr. Lockyer left the spectroscope to study the structure of the corona with the telescope, and Dr. Schuster uncovered all the lenses of his camera—all four of them arranged on a single stand—and to all, except the observers, the sun's atmosphere shone out in all its splendour and majesty, and the roar increased on the hill. In the telescope the verdict was that the solar conditions of 1871 were again present; and at the signal "40 seconds more," the information to be gathered by the naked eye and the gratfng was to be sought by one observer, while the photographic plates had to be changed by another. At this moment the silence in the observatory was broken by shouts calling attention to a strange object among the fainter exterior details of the corona itself, which were more suspected than seen. There, one solar diameter to the right and one solar diameter long, was an exquisitely formed comet, complete with nucleus and tail, sweeping in a beautiful curve, in brilliancy almost, if not quite, equalling that of the very corona itself—a real photometer, in fact, of which we have not yet heard the last. As in the naked eye view there was a struggle with the comet, so with the grating there was a struggle of another kind. A prism or a diffraction grating used without lenses forms what is called a slitless spectroscope. The coronal ring is really used as a circular slit, and according to the substances present in the solar atmosphere we shall have rings or no rings; and if rings are seen, then their presence in

certain definite positions will tell us what substances are present. Now, in 1871 rings were seen, and they were very bright. In 1878 no ring whatever was seen. The question to be decided, then, was, Did this year's eclipse resemble in this respect the eclipse of 1871 or 1878? The result of the inquiry was that there were rings, but that they took time to see. This indicated a solar condition more resembling that presented in 1871 than in 1878, but stopping short of it.

Owing to these difficulties, hardly had Mr. Lockyer time to pass back to the telescope by means of which the spectrum of the corona was to be studied, when the clock showed that sixty-five seconds had elapsed, and Mr. Buchanan's "over" filled all with regret that the phenomenon, so rare and beautiful, and full of such precious knowledge, which each was doing his "level best" to secure, should be so ephemeral. So the caps were put on the cameras by Dr. Schuster and his assistant, Mr. Woods, lest the precious records which it was hoped might have been secured thould be spoiled by the first beam of the reappearing sun. It turned out, however, that so admirably had the eclipse been calculated, and so exactly had the French party hit upon the central line, that the totality really lasted 7 seconds more, that is, the full 72 seconds. The spectrum of the corona, therefore, was studied for a second or two under, perhaps, better conditions than had ever been present before, excepting during the memorable observation of Janssen in 1871. There were the red and green and blue lines stretching right across a wide field of view, and although no obvious dark lines were seen in the momentary glimpse, it was obvious that the spectrum was not truly a continuous one. There were variations of intensity here and there, and not the equal toning generally observed. So then ended the totality in one of the observatories. Dr. Schuster and his assistants at once proceeded to the extemporised dark room on board the steamer to develop the photographs, while those members of all the parties who had made telescopic or spectroscopic observations retired to the solitude of their tents to write down their results while they were still fresh in their minds.

Later on in the day there was a conference, at which the collective note, which I have already telegraphed to you, was drawn up and signed on behalf of the several expeditions. The observations were thought then, and are thought now, to have been a splendid success. The photographic results obtained by Capt. Abney's rapid plates have secured permanent records of the highest value, which largely increase our knowledge of the sun's atmosphere. They connect the spectrum of the sun with that of the stars in a most unmistakable manner; and, taken in connection with the observations of Lockyer and Trépied on the bright lines visible before totality—observations predicted a year ago in the teeth of received opinion—show that those who would explain solar phenomena in the light of terrestrial chemistry have their work cut out for them. But on this and on some other matters I may have something to say in a subsequent letter.

The Cairo Correspondent of the *Daily News* telegraphs on Monday:—

By order of the British Government, Sir E. Malet has officially thanked the Khedive for the great attention and services rendered to the Eclipse Expedition. The Khedive has returned a complimentary answer. No other Consul has yet thanked his Highness.

## *AURORÆ IN GREENLAND*[1]

SINCE the publication of the researches on Auroræ by Baron Nordenskjöld, the study of this enigmatical phenomenon has acquired still more attraction for the student of the physics of the globe. We are glad, therefore, to notice the appearance of a new work on "Auroræ," published by the Danish Meteorological Institute, being a discussion, by M. Sophus Tromholt, of the fifteen years' observations (1865-1880) made by M. S. Kleinschmidt at Godthaab in Greenland.

The auroræ at Godthaab are seen, of course, almost exclusively in the southern part of the sky. "I do not remember," M. Kleinschmidt says, "to have seen during these last twenty-five years, more than a few times, any aurora in the north; the middle point of the aurora-arc is usually situated between due south and south-south-east, with small oscillations on both sides of this middle point. In all colonised parts of the western coast of Greenland, the auroræ are always seen towards the south; but it seems to me that at the southern extremity of this country, I have observed more intense auroræ extending throughout the whole of the sky." This observation fully confirms the conclusions of Baron Nordenskjöld, as will be seen from his map, which we reproduced (NATURE, vol. xxv. p. 371). Godthaab being situated in 64° 11′ N. lat., that is, in the third region of Nordenskjöld, the exterior circle of the glory must appear as a bow in the south, and the common, or interior one, as a luminous arc in the magnetic north, or, rather, as a light spread throughout the sky. Indeed, northern auroræ were seen at Godthaab only during twenty-five days, out of fifteen years, and their number was but forty in the morning hours, and sixteen in the evening. At Jacobshavn (69° 13′ N. lat.) 50 per cent. of all auroræ are seen towards the south east, 26 per cent. towards the east, and only 9·5 per cent. appear in that part of the sky which is comprised between north-west and north-east. At Upernivik (72° 47′ N. lat.) the disproportion is still greater, 74 per cent. of auroræ appearing between south-east and south, 14·5 towards the east, and only 4·8 per cent. between north and west. As to the frequency of the quiet arc-aurora (the "glory" of Nordenskjöld), as compared with that of the brilliant ray-auroræ, it is difficult to judge by the abstracts of observations published by M. Tromholt, inasmuch as the observer seems not to have attached great importance to this difference; but it results from what he says that the most frequent shape is that of a luminous arc "whose rays are diffused so that the luminous mass seems to be homogenous." The rays are often only pulsations in the arc itself. As to the fascinating and brilliant ray-auroræ, they are by far less frequent than the former; however—in accordance with Nordenskjöld's theory—they are not uncommon in this latitude. The height of the middle point of the arc is usually from 5° to 10° above the horizon. Feeble light, very much like twilight, is not uncommon, as well as a similar light spread throughout the sky. M. Kleinschmidt has also observed auroræ in the shape of "an immense column of smoke," consisting of more or less defined rays: "it nearly always appears in the same position, starting from a point between north-east and east-north-east, whence it crosses the zenith and reaches an opposite point of the horizon." The same was observed in the "common arc" by Nordenskjöld (NATURE, vol. xxv. p. 369, Fig. 5).

The number of auroræ extending beyond the zenith, or appearing in the northern part of the sky being anything but numerous, it is only with caution that we may admit the conclusion arrived at by M. Tromholt as to a periodicity in the oscillations of the "auroral belt;" but it is worthy of notice that his conclusion is the same as that arrived at by Weyprecht, namely, that "the auroral belt advances towards the south about the autumnal equinox, then moves towards the north, and reaches its most northern position about the winter solstice; thence it again moves towards the south, and occupies its most southern position about the spring equinox; after that it again returns towards the north." If confirmed by more extensive observations, this result would imply an

[1] "Om Nordlysets Perioder, efter Iakttagelser fra Godthaab i Grönland." Af Sophus Tromholt. (Publication of the Danish Meteorological Institute.) Copenhagen, 1882.